

THE QUANTIFICATION OF THE SOIL EROSION IN THE HILLY ZONES FROM MOLDAVIA AND OLTENIA

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Abstract: Taking account that lately, the erosional process on the slope soils has intensified both by non rational exploitation of the woods and arable land and by the improper technological system, especially on small farms, there is need to know the size of this phenomenon and to find the vulnerable zones and recovery measures. Worldwide researches on this domain are multiple, especially in Northern European countries that have large slope surfaces, e.g. Scotland, UK, Norway, Finland, Sweden, Germany who have evidenced this phenomenon for agricultural ecosystems. In our country there have been made researches in the last years at the Research Centre for Erosion Control Perieni, District Vaslui. Having as a base the 52-149/2008 Research Project: „Researches on the soil and nutrient losses within the hilly zones of Moldavia and Oltenia” we have initiated researches in these two zones in order to quantify the soil erosion. The researching method has used standard plots for controlling runoffs on verstants from Valea Tarinei (Moldavia) and Preajba (Oltenia). The plots have been cropped as follows: soybean, beans, bromus, wheat, corn, furrow,

natural and sown pasture, being fertilized by different mineral fertilizers. On the basis of collected runoffs after each rain there were made determinations of eroded soil. These researches are a novelty in this domain because it is the first time when there are determined the quantities of eroded soil on slope under different crops evidentiating the harmfulness of the erosion phenomenon. The researches have been limited by the slope of the land and by the rainfall in the two studied zones, Valea Tarinei (Vaslui) and Preajba (Gorj). These researches have a large aplicability in practice due to evidentiating for winter cereals, wide row crops and pastures the soil quantities that can be lost and warn the farmers about the most appropriate tillage on slope land. The paper is original by its researching method as well as by elaborating diagrams for each rain and for each crop emphasizing the following issues: the span of the rain (mm), liquid runoff (me/ha), the runoff coefficient and the rosion tones/ha. The paper has a special importance because it warn attention on preserving the soil according with the European Directive of Preserving Soil Quality.

Key words: erosion, standard plots, fertilizer doses, rain diagram, liquid runoff, eroded soil

INTRODUCTION

The soil erosion is the phenomenon of mechanical nature that unfolds at the soil surface characterized by three main phases: disclosure (detaching) of the soil particles, the transport and deposition of the sediments (POPA N., 2005). It consist of losing soil particles by water or wind action.

No matter the erosion type, it determines a strong environmental and economical impact.

The ecological impact consists in diminishing the thickness of the fertile layer yet by modifying the main phisical, chemical and biological features of soils, it increases the clogging of lowlands, it harm the landscape and biodiversity (DUMITRU, 2007).

The economical impact consists of humus losses, the decreasing of soil productivity, leaching and taking away of seeds.

DUMITRU (2007) estimates that the agricultural lands with erosion potential spread in Romania on 6.4 million ha (43%) with an annual quantity of eroded soil of 126 million tones.

Worldwide, there have been elaborated mathematical models of simulation of

hidrological processes and/or erosional as ANSWERS – University of Arkansas, ARM – Agricultural Runoff Management, HYDROCOMP INC, CREAMS – Chemical Runoff and Erosion from Agricultural Management System as well as the European COST Program. Also, there are numerous researches carried out in this domain of which we quote Asghornpaur – Iran, Demidov – Russia, Finer – Germany, Jakos – Hungary, Lippe – Vietnam have shown the gravity of the phenomenon yet, especially, the measures for reducing or diminishing it.

MATERIAL AND METHODS

In order to establish the soil quantities that are lost by water erosion in the two centres, Perieni – Vaslui and Preajba – Gorj, there have been used different researching methods.

At the Researching Center for Erosion Control Perieni there were used 10 standard plots with the following dimensions and crops:

- eight plots have had 100 s.m. and two plots have had 150 s.m. (nr. 7 and nr. 8). They have been cropped by soybean (1), beans (2), bromus (3), wheat (4), corn (5), furrow (6 and 7), soybean (8), wheat (9), corn (10) in a two years crop rotation. The first 5 plots have been fertilized by 150 kg/ha complex fertilizer 28-28-0 in the fall and in the spring by 150 kg/ha ammonium nitrate, the furrow, wheat and corn were not fertilized.

- The soil where these plots were set up is a cambic chernozem mezo and baticaric moderately eroded, on loesses deposits, having the following physical and chemical features:

- The soil reaction is moderately to low acid (pH 5.25 – 6.28)
- Average supplied by nitrogen (humus = 2.66-3.64%, Nt = 0.22-0.27%)
- Low and average supplied by available phosphorus (7.01-21.9 ppm P)
- Well supplied by available potassium (135-174 ppm K)
- Low content of Zn (0.18-0.53 ppm), Cu (0.46 – 0.98 ppm), average by Mn (31.32 – 62.98 ppm) and iron (45.52 – 53.66 ppm)
- The texture is silty loamy in Am and A/B, Bv, Cca and loamy sandy in C horizon.

In 2010, the temperatures and rainfall have differed from multiannual values as follows: from thermal point of view there were recorded values of monthly average temperature higher than the multiannual value by 0.1⁰C till 3.4⁰C. During July and August there were recorded maximal temperatures of over 30⁰C (35.7⁰C in June, 33.2⁰C in July and 37.4⁰C in August).

As regard the rainfall they were under the average of the zone in January, March, April and May (table 1). During the observations, 16.11.2009 – 15.11.2010 there were recorded 12 rains that determined runoff and erosion.

Table 1

The monthly and annual average temperatures and rainfall as compared with the multiannual average in 2010

Specification	Month										Σ
	I	II	III	IV	V	VI	VII	VIII	IX	X	
Av. temp. 2010	-5.0	-0.5	4.5	11.3	17.0	21.0	22.8	24.3	16.1	7.7	
Multi annual average	-3.0	-1.1	3.4	10.3	16.0	19.6	21.5	20.9	16.2	10.3	
Deviation	-2.0	+0.6	+1.1	1.0	1.0	0.5	1.3	3.4	-0.1	-2.6	
Rainfall Mm	18.5	42.4	14.7	18.5	46.0	115.3	75.4	71.6	55.9	62.2	502
Multi annual average	24.9	24.5	24.4	40.1	54.6	75.6	61.2	49.9	41.2	31.5	427
Deviation	-6.4	+17.9	-9.7	-21.6	-8.6	39.7	14.2	21.7	14.7	30.7	74.1

At the Research Centre for Pastures Preajba – Gorj there were used 9 plots on a 6% slope that were cropped and fertilized as follows:

Corn N162P82K100 (NPK)
 Corn N132 (N)
 Corn – not fertilized control
 Sown pasture N162P82K100 (NPK)
 Sown pasture N132 (N)
 Sown pasture – not fertilized control
 Natural pasture N162P82K100 (NPK)
 Natural pasture N132 (N)
 Natural pasture – not fertilized control

The soil in the experiment is a stagnic luvisol on clay silty – sandy / clayey – silty at the top of the slope and stagnic luvisol on silt and as texture, silty-sandy / clayey – silty at the bottom of the slope with silty – sandy and clayey – silty texture, with a moderate to low acid acid reaction at the surface (pH = 5.29 – 5.46) average supplied by nitrogen (Nt = 0.14-0.17%), very low supplied in available phosphorus (0.35-2.27 ppm P) and low supplied by available potassium (41.2-51.6 ppm K) and average content of microelements as Zn, Cu, Fe and Mn.

The climate is continentally temperate, with evident mediterranean influences. The average multiannual temperature is 10.3°C and the rainfall are 433.1 mm.

Table 2

The monthly average temperatures and rainfall as compared with the multiannual average within 1980-2010 period at Preajba – Gorj

Specification	Month										
	I	II	III	IV	V	VI	VII	VIII	IX	X	Σ
Av. temp. 2010	2.8	2.9	7.8	11.8	16.8	21.2	22.4	23.5	15.5	11.4	
Multiannual average	-1.1	0.7	5.0	10.8	16.5	19.9	21.9	21.2	16.0	10.7	
Deviation	-1.7	2.2	2.8	1.0	0.3	1.3	0.5	2.3	0.5	0.4	
Rainfall Mm	23.1	14.8	47.7	73.2	40.2	91.8	91.5	27.6	130.2	60.4	459
Multiannual average	45.8	38.7	42.8	61.3	79.8	85.2	77.9	63.1	66.8	53.5	433
Deviation	-227	-239	49	119	-396	66	136	-355	634	69	20.4

RESULTS AND DISCUSSIONS

a) Regarding the erosion at Perieni on baticalcic chernozem

Cumulating the liquid runoff of water and soil that have resulted after 12 rains there are obtained the erosion results on 100 s.m. or 150 s.m. that are transformed at hectare; these data are written in the third table. Filtering these liquid runoffs we have get the quantity of eroded soil on a plot and on hectare, also written in the third table, figure 1 and 2 as rains diagram. These results emphasize the following aspects:

- the liquid runoff within november 2009 and october 2010 are between 48.0 and 1,126 m³/ha. They have been higher with the two furrow plots of 100 and 150 square meters, of 686.8 and 1,126.8 m³/ha that emphasizes the fact the larger the surface the higher the runoff;
- Just after the furrow plot there follows the fertilized corn plot, with 202.05 m³/ha and the soybean one of 150 s.m., with 215.8 m³/ha;
- The lowest values of the liquid runoff were recorded with not fertilized wheat, of 48.1 m³/ha and bean, of 76.2 m³/ha which are the crops that cover the land best.

As regard the quantity of eroded soil, it is, generally, correlated with the quantity of liquid runoff but not in all plots. Thus, with a lower volume of runoff, of 196.6 m³ with not

fertilized corn there are lost through erosion 20.7 t/ha while with a similar volume of liquid runoff yet with fertilized corn there are only lost 3.9 t/ha and with soybean 5.2 t/ha that proves the better developed is the crop the lower the quantity of eroded soil due to better developed root system that retain a higher quantity of soil.

Table 3

The quantification of the erosion by liquid runoff and the eroded soil at Perieni in 2010 in function of crops

Plot	Crop	Liquid runoff m ³ /ha	Lost soil by erosion t/ha
1	Soybean 100 s.m.	188.1	5.2
2	Bean	76.2	2.6
3	Corn	202.1	3.9
4	Furrow 100 s.m.	686.8	40.2
5	Furrow 150 s.m.	1,126.8	97.5
6	Soybean 150 s.m.	215.8	5.3
7	Wheat – not fertilized	48.1	0.3
8	Corn – not fertilized - rotation	196.6	20.7

The most advanced erosion was recorded with the furrow plot where the quantity of eroded soil was very high, of 40.2-97.5 t/ha, followed by not fertilized corn in rotation with wheat, of 20.7 t/ha.

b) Regarding the erosion on the stagnic luvisol at Preajba

Taking account of the clayey texture of the stagnic luvisol from Preajba that is more stable and less rainfall, the volume of runoff and eroded soil has been more reduced as compared with the batocalcaric chernozem from Perieni (table 4).

Table 4

The quantification of liquid runoff and the quantity of eroded soil at Preajba – Gorj, in 2010 with different fertilized crops

Plot	Crop	Liquid runoff m ³ /ha	Lost soil by erosion t/ha
1	Corn -N162P81K80	756.5	4.72
2	Corn-N138	794.3	5.01
3	Corn-Not fertilized	821.5	5.26
4	Sown pasture-N162P81K80	522.6	0.55
5	Sown pasture-N138	582.7	0.60
6	Sown pasture-Not fertilized	611.5	0.68
7	Natural pasture-N162P81K80	518.4	0.45
8	Natural pasture-N138	533.2	0.51
9	Natural pasture-Not fertilized	571.3	0.62

From these data there results that the highest volume of liquid runoff and eroded soil is recorded with the corn crop, with values of 756.5-821.5 m³/ha liquid runoff and 4.72-5.26 t/ha eroded soil.

With the corn crop, the highest erosion is recorded with the not fertilized corn that develops a shallower root.

With the sown and natural pasture the erosion is very low as compared with corn though there is recorded a high volume of liquid runoff, of 518.4-611.5 m³/ha. The eroded soil is of 0.45-0.68 t/ha.

The lowest erosion of all variants is recorded with natural pasture fertilized with NPK, of 0.45 t/ha eroded soil.

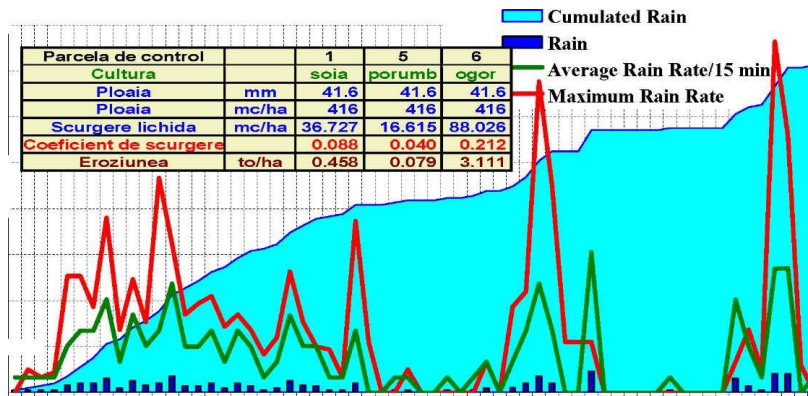
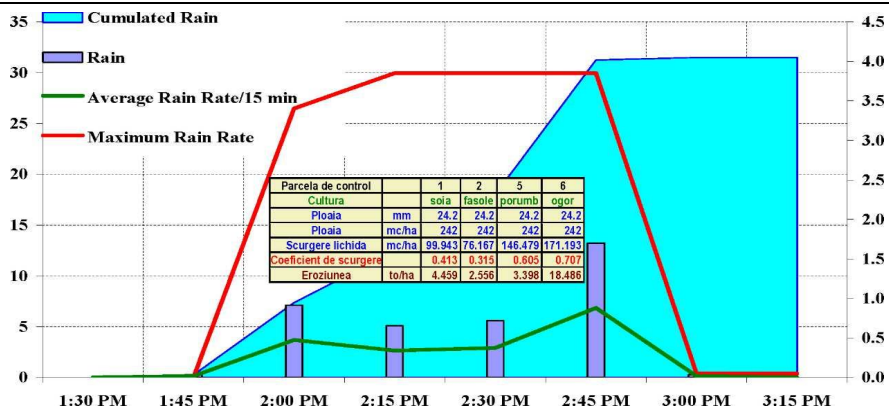


Figure 1-2: Rainfall diagrams

CONCLUSIONS

- Text soil erosion is more accentuated on the mezo and baticalcric cambic chernozem from Perieni (Vaslui) than on stagnic luvisoil from Preajba (Gorj) because of clayey texture of the second soil type;
- the highest erosion is recorded with the furrow plots where the quantity of eroded soil reaches 97.5 t/ha per year;
- wide row crops like corn and even soybean determine a higher erosion as compared with other crops like wheat – 20.7 t/ha of eroded soil as compared with 0.3 t/ha;
- on natural and sown pastures that are fertilized the erosion is very low, of 0.45-0.68 t/ha of eroded soil;
- on slope land there are recommended crops that cover the soil like natural and sown pastures, cereals but not wide row crops.

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